An Apparatus and Method for Optimizing the Efficiency of Germanium Junctions in Multi-Junction Solar Cells

ABSTRACT

Apparatus and Method for Optimizing the Efficiency of Germanium Junctions in Multi-Junction Solar Cells. In a preferred embodiment, an indium gallium phosphide (InGaP) nucleation layer is disposed between the germanium (Ge) substrate and the overlying dual-junction epilayers for controlling the diffusion depth of the n-doping in the germanium junction. Specifically, by acting as a diffusion barrier to arsenic (As) contained in the overlying epilayers and as a source of n-type dopant for forming the germanium junction, the nucleation layer enables the growth time and temperature in the epilayer device process to be minimized without compromising the integrity of the dual-junction epilayer structure. This in turn allows the arsenic diffusion into the germanium substrate to be optimally controlled by varying the thickness of the nucleation layer. An active germanium junction formed in accordance with the present invention has a typical diffused junction depth that is 1/5 to 1/2 of that achievable in prior art devices. Furthermore, triple-junction solar cells incorporating a shallow n-p germanium junction of the present invention can attain 1 sun AM0 efficiencies in excess of 26%.